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Devolved fiscal powers, increased competitiveness and 'levelling up': a simulation approach

Kevin Connolly[a] , Alastair Greig[b] , Peter G. McGregor[a] , Graeme Roy[c] and J. Kim Swales[a]

ABSTRACT
The UK levelling up agenda includes a commitment to devolution, but there has been little attempt to model the operation of possible accompanying regional tax powers. We use computable general equilibrium simulations to analyse the local impacts of regional tax cuts. These reduce production costs, thereby stimulating regional economic activity. But the financing of any subsequent deficit and the operation of the regional labour market determines the size, nature and dynamics of resulting economic outcomes. Further, the decision to target labour or capital costs has implications for a range of regional economic impacts.

KEYWORDS
regional policy; 'levelling up'; computable general equilibrium modelling; regionally differentiated tax impacts; inter-regional migration

1. INTRODUCTION

The 2016 referendum vote to leave the European Union has been widely interpreted, by both politicians and other commentators, as being at least partly a populist revolt against spatial inequality in the UK (McCann & Ortega-Argilés, 2021; Rodríguez-Pose, 2018). Subsequent UK governments have committed to what has come to be called the 'levelling up' agenda. The nature and scale of the challenge for levelling up policies in the UK is extensively described and analysed by Martin et al. (2021) and HM Government (2022a). However, the precise composition of this agenda is still unclear, but it has at least two strands.

One key element is the belief that UK public sector decision-making is too centralised (McCann, 2022). The initial implicit claim seems to have been that peripheral regions are disadvantaged because their needs are geographically distant from, and therefore not recognised by, a metropolitan elite.[1] But these arguments have subsequently been extended to advocate a greater degree of local decision-making for all regions, including London (Centre for Cities, 2023).

This view seems to be supported by the UK Conservative government, which has pledged greater devolution in England, whilst strengthening the union between England and the already-devolved nations of the UK. The Conservative Election Manifesto claimed to 'remain committed to devolving power to people and places across the UK. Our ambition is for full devolution across England … so that every part of our country has the power to shape its own destiny' (Conservative Party, 2019). This ambition is confirmed in the government's recent White Paper on levelling up, which states: 'By 2030, every part of England that wants one will have a devolution deal with powers at or approaching the highest level of devolution and a simplified, long-term funding settlement' (HM Government, 2022a, p. 7).[2]

Nevertheless, there has been as yet no attempt to frame debates over English devolution or levelling up in the context of the enhanced tax powers already given to – and increasingly demanded by – the UK's existing devolved authorities in Northern Ireland, Scotland and Wales. Following the Scotland Act 2016 and Welsh Act 2017, the devolved governments in Scotland and Wales have significant control over regional income tax policies. UK legislation had also been passed for corporation tax to be devolved to Northern Ireland and the Scottish National Party (SNP), which leads the Scottish government, is a

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long-time advocate of transferring similar corporation tax powers to Scotland.[3] If one aspect of the levelling up agenda is to devolve more decision-making to English regions, then a degree of tax decentralisation might also be appropriate.[4] Again the government seems to be moving in that direction with greater local taxation powers being promised to the Manchester and Birmingham metropolitan mayors.

The second key element in the levelling up debate is that resources should be redirected so as to reduce differences in life chances across spatial areas. The White Paper 'Levelling Up the United Kingdom' emphasises the extent of social and economic inequalities across the UK (HM Government, 2022a, 2022b). Much of the discussion on future policy concerns the delivery of national programmes covering areas such as health, housing, transport and education so as to bring about better outcomes in what have been labelled 'left behind' regions. But since leaving the EU, the UK government also has the power, and the expressed commitment, to revise and strengthen regional policy which would implicitly favour specific regions through spatially targeted policies (Centre for Cities, 2020; Davenport & Zeranko, 2020; HM Government, 2022a).[5] In this context allowing certain lagging regions a degree of devolved fiscal power might be regarded as an appropriate policy for spatially rebalancing the economy. This would be especially the case if it were felt that the region's suboptimal economic performance was the result of inappropriate policy decisions made by the centre.

However, there are alternative, more traditional, regional policy measures at present operational in the UK. The most visible spatial policy is the Levelling Up Fund where local authorities bid for centrally funded grants primarily to finance local infrastructure improvements (Department for Levelling Up, Housing and Communities (DLUHC), 2023). But spatially differentiated, centrally financed, tax reductions have in the past, and are at present, also used as a policy instrument. An example is the UK government's working 'in partnership with ports, businesses, local authorities, and wider stakeholders through a public consultation to develop a highly ambitious, world leading Freeports model for England' (DLUHC, 2022). This identifies eight freeport sites in England with an additional freeport in each of the devolved regions.[6] One of the key aspects of a freeport location will be access to a suite of tax reliefs which includes employer national insurance contributions.[7]

In this paper we use a computable general equilibrium (CGE) model, calibrated on Scottish data, to simulate the impact of devolved fiscal powers to set specific tax rates. In this analysis we take Scotland as a representative UK region. The Levelling Up White Paper specifies three headline metrics for its mission to improve living standards and reduce existing regional disparity: gross value added (GVA) per hour worked, gross median weekly pay and the employment rate for 16–64-year-olds. We evaluate the effectiveness of reducing local taxes on these and a range of other measures reflecting regional economic activity (including past objectives of regional policy) and test the sensitivity of these outcomes to changing the migration and financing conditions. We contrast the regional economic impact of separately reducing the level of two taxes, the employers' national insurance contribution and corporation tax. These are modelled as a proportion of wage and profits payments, respectively.[8] These two taxes are symmetrical in that they are both paid by firms, and an identical analysis would apply to the long-run impact of comparable subsidies on investment and employment.[9] We demonstrate the wide applicability of our framework by exploring how a range of key characteristics of regions impact our results.

To reflect the uncertainty surrounding the precise nature of the government's plans, we perform three types of simulation. These basically mirror three possible broad strategies that incorporate a regional reduction in the tax on a factor input. In all cases we use the stand-alone, single region CGE model. In Levelling Up 1, we assume that the tax reduction occurs in only one region but is financed through the central government so that there is no change in regional public expenditure. This corresponds to the central government subsidising production in the region. In Levelling Up 2, we again assume that the single region has devolved tax powers but must meet any changes in revenue raised by the tax by adjusting its current public expenditure. This is a policy that stresses appropriate decision-making and accountability for regions that have been left behind. In Levelling Up 3, the model is configured so that it is as if the national economy consists of identical regions, all of which adopt the same tax reduction. This is a policy which conceives national economic activity as being stifled by excess centralisation.

The rest of the paper is structured as follows. Section 2 outlines and motivates our modelling methods and approach. Section 3 summarises the model structure, Section 4 discusses our simulation strategy and long-run results are presented in Section 5. Section 6 considers the dynamics of adjustment and Section 7 discusses the implications of the results. Section 8 concludes.

2. MODELLING METHODS AND APPROACH

In this section we explain and justify the specific modelling approach that we take. We begin with the decision to use a single-region, rather than a multi-regional, model. In the levelling up debate, weight has been placed on the unique characteristics of individual regions, the emphasis on local knowledge for directing policy interventions and the piecemeal nature of the roll out of the policy up to now.[10] A civil servant from the Levelling Up Department stated that the difficulty of evaluating existing local economic growth policies reflected 'the inherent complexity of understanding how local economies grow, and the precise mix of interventions needed and the engagement between private sector and society, varied from place to place'

(House of Commons Committee for Public Accounts, 2022, p. 14).

The Levelling Up White Paper gives no indication that the government sees the national economy as operating as an integrated whole, or any notion of a consistent spatial economic structure. Rather, atomistic local economies are described as having a range of physical, intangible, human, financial, social and institutional resources (there labelled as 'capitals') which determine their present performance.

Given this background, it seems appropriate for the asymmetric devolution of Levelling Up 1 and 2 to be analysed with a single-region model. Such a modelling approach does not assume that policy interventions in the region have no impact on the rest of the country but rather that the feedback to the original region is of second-order magnitude. In implementing levelling up programmes, local policymakers are being tasked with deciding what is best for their region; wider spillovers and consequences outside the region are essentially not their concern. This perspective is reflected in the strategy documents published by both UK devolved and city-regions (HM Government, 2019; Scottish Government, 2022).[11]

This is not to deny that inter-regional spillovers, both positive and negative, and the optimality of local incentives for achieving national economic objectives is a concern (McGregor & Swales, 2005). Such an analysis would be valuable and would imply adopting a multi-regional economic and policy approach. However, at present, we simply do not know how, and on what geographic scale, this devolved power will operate in England. We also have a lack of regional information to assemble, with any degree of confidence, the data base to construct an inter-regional model on this scale.

Nevertheless, the simulations under Levelling Up 3 yield insight into the consequences of a policy that essentially simply devolves fiscal powers to all regions. In these simulations, regions simultaneously seek to 'level up' through reductions in local tax rates. Strictly, the case assumes a system of identical regions all of whom have an equal degree of fiscal autonomy and who, in equilibrium, pursue identical policies. The results of this case can, however, be used to infer the impact of less restrictive circumstances where, for example, only some regions pursue the fiscal policies or regions are heterogenous.

The second issue is the choice to use CGE simulation, as against fixed-coefficient extended input–output (IO) or some form of econometric modelling. We chose the CGE approach since it is particularly suited to an ex ante analysis of a novel devolved tax policy in the UK;[12] the policy interventions have both demand- and supply-side impacts so fixed coefficient models such as IO are inappropriate; and the UK has inadequate data to develop a structural econometric approach, which can fully accommodate the supply side.

Note that we are not primarily interested in point estimate predictions; we are not evaluating a specific policy proposal. Rather we are using the CGE model as a simulation framework, as a numerical tool, to aid analysis and policy discussion. We are interested in uncovering the underlying factors that would operate in these situations, the relative size of different effects and their sensitivity to variations in key parameter values. The model is parameterised on actual data concerning the structure of the economy, but aspects of the economy, such as openness to trade and migration, can be altered. This is important in this case given the regional heterogeneity stressed by the present UK government.

A final question concerns the use of Scottish data to parameterise the model. Scotland has the best and most complete UK regional data for such a modelling exercise. It has an up to date, survey-based analytical IO table and government accounts. Scotland also already has the authority to change income tax rates so that estimates of the existing tax take are available. However, our aim is to have model results that will help inform the debates over the value of devolved tax powers in other regions too. One issue is the representativeness of Scotland's economic structure.

In discussing devolved powers, the UK government seems to take the mayoral combined authorities (plus Greater London Authority) as appropriately devolved areas (HM Government, 2022b).[13] There are at present 10 combined authorities in England, which, including London, cover 40% of the population. England has nine NUTS-1 regions[14] and 33 NUTS-2 regions so that these devolved areas would sit somewhere between the two in terms of scale; closer to NUTS-1, which is the scale of the Scottish model. In 2020, Scotland's per capita gross domestic product (GDP) was 92% of the UK average, but only London and the South East region had above average scores. Scotland comprises four of the 41 UK NUTS-2 regions, which in 2018 were ranked fourth, ninth, 20th and 41st in terms of per capita GDP.

The ability to vary key features of the model, including its openness to trade and the spatial mobility of labour and capital, give it a non-specific regional character. Crucially, having the capacity to interpret the simulation results as applying to a generic region adds insights concerning the trade-offs and opportunities exhibited by regionally led fiscal policies for any small region across the UK (and beyond).

3. THE AMOS CGE MODEL

We use a variant of the AMOS CGE model calibrated on the 2013 Scottish IO accounts (Harrigan et al., 1991; Scottish Government, 2021).[15] This version of the model has 18 competitive industrial sectors/commodities, three internal institutions – households, firms and governments – and two external sectors, the rest of the UK (RUK) and the rest of the world (ROW). The region – Scotland – is treated as a small open economy so that RUK and ROW variables are taken to be exogenous.[16] Financial flows are not explicitly modelled, and the interest rate is exogenous and fixed. This section provides a short account of key model relationships; Appendices B

and C in the supplemental data online give a full listing of all the model equations and summarise key parameter values.

The AMOS modelling framework has been used in many applications and allows flexibility in the choice of model closures and parameters (Allan et al., 2014; Congreve et al., 2022; Connolly, 2020; Figus et al., 2018). In the model, producers minimise cost using a nested multi-level constant elasticity of substitution (CES) production function. The combination of intermediate inputs with RUK and ROW inputs is based on the Armington function (Armington, 1969).

There are four components of final demand: household consumption, investment, government expenditure and exports. Household consumption is a linear function of real disposable income, with a fixed savings rate rendering consumption myopic, rather than forward looking. Exports are determined through an Armington link and so are governed by exogenous extra-regional demand and regional competitiveness, which is given by the ratio of regional to extra-regional prices. In some simulations in the present paper, government expenditure is exogenous and fixed; in others it is endogenous and determined through a budget constraint, detailed in Section 4.

In the first period, capital stocks are fixed both in aggregate and in their distribution across sectors. However, subsequently each sector's capital stock is updated between periods through investment, in line with the neo-classical investment formulation of Jorgenson (1963) represented by equation (1):

$$INV_{I,T} = KS_{I,T} * \delta + (KST_{I,T} - KS_{I,T}) * 0.5 \quad (1)$$

In each period and in each sector, gross investment, $INV_{I,T}$, is set as a fraction of the gap between the desired, $KST_{I,T}$, and actual, $KS_{I,T}$, capital stock plus depreciation at the rate δ. In the long run, in each sector actual and desired capital stocks are equal so that net investment is zero with gross investment just equalling depreciation.[17]

Since the UK left the EU and the inception of COVID-19, there has been uncertainty concerning wage setting and inter-regional migration. We therefore use two migration closures which, together with the period-by-period and long-run perspectives, give several labour market options.[18] In all cases we impose a single labour market, a bargaining function and perfect sector mobility. This is shown as equation (2), where the real wage, WR_T, depends negatively on the unemployment rate, UN_T, and α is a calibrated constant (Blanchflower & Oswald, 2005). This formulation is generally known as a wage curve:

$$\ln WR_T = \alpha - 0.113 \ln UN_T \quad (2)$$

In one option the labour force is held fixed. This follows Basile and Lim (2017) who maintain that migration responses exhibit a clear inertia to wage differentials. In the second, shown as equation (3), the regional labour force is allowed to vary through flow-equilibrium inter-regional migration (Treyz et al., 1993).[19] In this case in each period, net migration, M_T^S, is determined by the real wage and unemployment rate differential between Scotland, S, and the RUK, UK, and σ is a calibrated constant:

$$M_T^S = \sigma - 0.08[\ln(UN_T^S) - \ln(UN_T^{UK})]$$
$$+ 0.06[\ln(WR_T^S) - \ln(WR_T^{UK})] \quad (3)$$

Again, no explicit forward-looking household behaviour is involved and the RUK values are assumed to be constant.[20] Under this closure, following an exogenous shock, net migration flows will ultimately re-establish the initial zero net migration equilibrium at the initial real wage. This can also be interpreted as representing a labour market where the long-run real wage is unresponsive to the tightness of the labour market.

Essentially external (ROW) prices act as the numeraire. This means that where the nominal wages or nominal prices change they do so relative to prices in the ROW (and the RUK in the case of Levelling Up 1 and 2). In long-run equilibrium with migration, so that the real wage and interest rates are fixed, prices are independent of the level of output. In this case output adjusts to achieve the new macroeconomic balance. Where there is a fixed labour force changes in output and the terms of trade, driven indirectly by the wage curve, operate to restore the new equilibrium. In Levelling Up 3 we assume a system of identical regions, all of which pursue identical expansionary fiscal policies, RUK prices are adjusted iteratively until a new long-run equilibrium is established in which competitiveness vis a vis RUK is ultimately restored.

4. SIMULATION STRATEGY

The model is initially calibrated to be in steady-state equilibrium. This implies that in the base period, net migration is zero and investment just covers depreciation. With no exogenous disturbances, the model replicates the initial values over all subsequent time periods. This implies that in all the simulations the reported changes in endogenous variables are directly or indirectly caused by the exogenous shocks.

In each simulation, we introduce a step fall in the rate at which either employers' national insurance or corporation tax is levied in the region. The changes are calibrated such that the direct reduction in revenue is identical for both taxes. This means that if there were no changes in endogenous economic variables following the cut in each tax rate, the impact on the local public sector budget would be the same.[21] The corporation tax rate falls by 3 percentage points, from 23% to 20%, which, in terms of lost revenue, corresponds to a 0.51% reduction in employers' national insurance.[22] In each simulation, once the shock has been introduced the model is then run forward with no other changes in exogenous variables until the long-run equilibrium is reached.

We generate results for combinations of the three Levelling Up policies and two labour market model closures to reflect the uncertainties discussed in Section 2. In Levelling Up 1 the regional government's consumption

is unaffected by the introduction of the tax and is fixed in real terms. The tax reduction here would represent central government's subsidising production within the region, reflecting the resource-reallocation focus of the levelling up agenda. It would correspond to the type of regional assistance employed in the UK in the 1960s and 1970s where automatic subsidies, such as regional development grants and regional employment premiums, were adopted in manufacturing, tied to the use of labour and capital in development areas (Armstrong & Taylor, 2000).

Under Levelling Up 2 and 3, the level of public expenditure is endogenous and is driven by balanced budget criteria, isolating the impact of fiscal decentralisation per se. We assume that the central government determines transfers and that the regional government(s) therefore adjusts public sector expenditure in the region in response to the variations in the local tax take. Any fall in the local revenue raised by the tax whose rate has been reduced is offset by a similar reduction in local public expenditure. This represents a situation where this single tax has been devolved. It corresponds to the arrangements that were in place to give the Northern Ireland assembly authority to reduce corporation tax.[23]

We model any endogenous adjustment in local public expenditure in a very simple way, so that the analysis stresses the straightforward, demand-driven impacts. First, we assume that the adjustments to the absolute size of the expenditure do not affect the composition of that expenditure. Secondly, although many aspects of public expenditure, such as infrastructure, health, education and transport, have supply-side effects, these are abstracted from here.[24]

The labour market closure where migration operates, driven by real wage and unemployment differences, might be thought to reflect the views of the UK 1980s' Conservative administration where Norman (now Lord) Tebbit claimed that his father, when unemployed in the 1930s, 'got on his bike and looked for work' (Tebbit, 1981). In this closure, any tightening of the local labour market will generate an inflow of inter-regional migrants which will continue until the initial labour conditions are restored (given that the region of interest is relatively small). For an initial decline in the wage rate the opposite will apply as the labour force contracts following outmigration.

The second labour market closure assumes zero migration so that the labour force remains unchanged at its initial value. This is closer to the view embraced by the recent Conservative Prime Minister Boris Johnson that 'for too many people, geography turns out to be destiny' (Johnson, 2021). However, note that although in this version of the model there is no geographical mobility, employment is not fixed as the local unemployment rate varies in response to changes in the real wage.

These two labour market options adopt opposite, limiting migration assumptions, with the likely outcome somewhere in between and varying among regions. (We explore this systematically in Section 5.3 below.) However, a model incorporating flow equilibrium migration, as

represented by equation (3), reproduces in the long run the key outcomes that would occur under a very passive (Keynesian) labour market. This is where the real wage is impervious to changes in labour market pressure. This might be thought to replicate the behaviour of the UK economy in much of the period since the financial crash.

In Levelling Up 1 and 2 only a single region has devolved fiscal powers; all other regions' prices are treated as exogenous. However, with devolved fiscal powers in a system of identical regions pursuing the same policy in order to stimulate their own economic activity, RUK prices can no longer be treated as exogenous. In this case we know that there would be no migration since real wages and unemployment rates all move identically. Further, the interregional trade effects would be quite different: the price level in the RUK would now fall, reflecting price reductions in each region. In turn this erodes the competitiveness gains in each region. A new equilibrium is established when the percentage changes in the representative 'own' region prices are identical to those in the RUK's, which we identify through iterative simulation.[25]

In the reported simulation results, we are particularly interested in aggregate regional economic variables stressed in the levelling up debate. This includes not only GVA/employee, the real wage and employment rate, but also GVA, investment, exports, employment, household consumption, government expenditure and competitiveness. Subsets of these variables have been the key targets for spatial economic policy in the past (Armstrong & Taylor, 2000). We focus initially on the long-run regional response to the tax changes. However, we also consider the way these impacts evolve over time. When the model is run in period-by-period dynamic mode, capital stocks and the aggregate labour force are updated between periods, using equations (1) and (3). These periods are interpreted as years, given that both the IO and the behavioural relationships employed in the model are benchmarked using annual data.

5. LONG-RUN SIMULATION RESULTS

Tables 1 and 2 show the long-run impacts of the reductions in corporation tax and national insurance contributions. Table 1 imposes flow equilibrium migration whilst in Table 2 the labour force is fixed. Recall that for Levelling Up 3, all regions use devolved fiscal powers simultaneously and equally. As the change in economic conditions in each region is the same, there is no incentive for migration so that the populations in all regions remain constant.

5.1. Flow equilibrium migration
The simulation results reported in the first two columns of Table 1 are for tax reductions under Levelling Up 1. They give the long-run effects of a cut in corporation tax and national insurance contributions applied solely in the subject regional economy with public expenditure fixed. Recall that the combined operation of the wage curve

Table 1. The long-run impacts of cuts in corporation tax (CT) and employers' national insurance (NI) with flow equilibrium migration across Levelling Up 1 and 2 policies (percentage changes from base).

	Levelling Up 1		Levelling Up 2	
	CT	NI	CT	NI
Gross value added (GVA)	0.73	0.66	0.52	0.46
GVA per employee	0.15	−0.04	0.19	0.00
Household consumption	0.35	0.43	0.22	0.31
Investment	0.93	0.61	0.77	0.46
Unemployment rate[a]	6.00	6.00	6.00	6.00
Change in unemployment rate (percentage point)	0.00	0.00	0.00	0.00
Employment	0.58	0.70	0.33	0.47
Total exports	0.82	0.71	0.82	0.71
Total imports	0.18	0.18	0.02	0.04
Nominal labour cost	−0.29	−0.80	−0.29	−0.80
Nominal wage	−0.29	−0.25	−0.29	−0.25
Real labour cost	0.00	−0.55	0.00	−0.55
Real wage	0.00	0.00	0.00	0.00
Consumer price index (CPI)	−0.29	−0.25	−0.29	−0.25
Government price index	−0.35	−0.46	−0.35	−0.46
Value added price index	−0.57	−0.55	−0.57	−0.55
Export price index	−0.41	−0.35	−0.41	−0.35
User cost of capital	−0.95	−0.20	−0.95	−0.20
Employer NI	0.30	−7.45	0.04	−7.66
Employee NI	0.30	0.44	0.04	0.21
Corporation tax (%)	−13.07%	0.40%	−13.20%	0.26%
Cost per job (£/FTE)	23,214	18,145	50,911	33,195
Scottish government expenditure	0.00	0.00	−1.18	−1.22

Note: [a]The unemployment figure is the actual unemployment rate, not the change in that rate. The base year value is 6%.
FTE, full-time equivalent.

and equilibrium flow migration implies a constant long-run real wage and employment rate.

Column 1 gives the results for the 3-percentage-point reduction in corporation tax. The exogenous tax adjustment reduces the cost of capital to all firms in the region which leads to a fall in the price of output across all sectors. As noted in Section 3, with constant returns to scale, exogenous import prices, and a fixed real wage and interest rate, long-run prices are independent of the level of output. The fall in capital costs generates further, knock-on, price reductions as the nominal wage and the price of intermediate inputs also fall. These price adjustments raise regional competitiveness, generating a 0.82% increase in total exports to RUK and ROW through a 0.41% fall in export prices.

The expansion in exports stimulates output, so that regional GVA rises by 0.73%. Although the prices of all commodities and primary inputs fall, they do not fall by the same proportionate amount with changes in the relative capital and labour costs to the firm having important implications in these simulations. With the corporation tax reduction, the nominal cost of labour is reduced by 0.29%, which simply matches the fall in the consumer price index (CPI). However, the corresponding decline in the user cost of capital is 0.95%. This reflects a combination of the fall in the price of capital goods and the reduction in corporation tax. As a result, production becomes more capital intensive with a 0.93% increase in investment, as against 0.58% and 0.35% increases, respectively, in employment and household consumption.[26]

The results in the second column of Table 1 record the national insurance Levelling Up 1 outcomes. The 0.66% growth in regional GVA is slightly lower than that registered under the cut in corporation tax and the composition of this increase in economic activity is rather different. The primary stimulus still comes through the increased regional competitiveness but in this case export prices fall by 0.35%, rather less than the 0.41% reduction with the corporation tax change, which reflects the relative capital intensity of the export sector. This means that with the national insurance adjustment exports rise only by 0.71%. However, the cost of labour to the firm now falls by 0.80% as against the 0.20% reduction in capital costs so that employment increases by more than investment, 0.70% as against 0.61%. Household consumption in this simulation rises by 0.43%.

Table 2. The long-run regional economic impacts of cuts in corporation tax (CT) and employers' national insurance (NI) contributions with no migration response across Levelling Up 1–3 policy frameworks (percentage changes from base).

	Levelling Up 1		Levelling Up 2		Levelling Up 3	
	CT	NI	CT	NI	CT	NI
Gross value added (GVA)	0.38	0.24	0.31	0.17	0.25	0.11
GVA per employee	0.38	0.24	0.31	0.17	0.25	0.11
Household consumption	0.28	0.35	0.16	0.23	0.1	0.17
Investment	0.62	0.23	0.59	0.21	0.51	0.12
Unemployment rate	5.81	5.77	5.91	5.87	5.95	5.91
Change in unemployment rate (percentage point)	−0.19	−0.23	−0.09	−0.13	−0.05	−0.09
Employment	0.20	0.24	0.10	0.14	0.05	0.1
Total exports	0.35	0.15	0.59	0.39	0.46	0.19
Total imports	0.18	0.18	−0.01	0.00	−0.13	−0.12
Nominal labour cost	0.24	−0.17	−0.03	−0.44	−0.16	−0.55
Nominal wage	0.24	0.38	−0.03	0.11	−0.16	0.00
Real labour cost	0.36	−0.12	0.17	−0.30	0.09	−0.37
Real wage	0.36	0.43	0.17	0.25	0.09	0.17
Consumer price index (CPI)	−0.12	−0.05	−0.21	−0.14	−0.25	−0.17
Government price index	−0.04	−0.1	−0.2	−0.25	0.27	−0.31
Value added price index	−0.21	−0.12	−0.4	−0.3	0.48	−0.37
Export price index	−0.17	−0.07	−0.3	−0.19	−0.35	−0.24
User cost of capital	−0.82	−0.04	−0.89	−0.11	0.92	−0.14
Employer NI	0.44	−7.29	0.06	−7.63	−0.11	−7.77
Employee NI	0.44	0.62	0.06	0.25	−0.11	0.10
Corporation Tax	−13.22%	0.19%	−13.30%	0.10%	−13.4	−0.02
Cost per job (£/FTE)	60,608	46,008	171,242	109,574	381,802	176,766
Scottish government expenditure	0.00	0.00	−1.19	−1.21	−1.08	−0.92

Note: FTE, full-time equivalent.

The figures in columns 3 and 4 of Table 1 give Levelling Up 2 results. With the long-run real wage fixed through the operation of flow-equilibrium migration, it is relatively straightforward to analyse the impact of imposing the balanced budget which takes the form of a reduction in public expenditure with no further price adjustments. The percentage change in labour cost and the user cost of capital do not vary across the Levelling Up policies 1 and 2 reported in Table 1. Similarly, the consumer, government, value-added and export price indices remain unchanged. This means that for this additional adjustment, the model acts as an extended IO system. Moreover, because the change in government revenues is similar under the two tax cuts the size of the subsequent adjustments is similar in the two cases.[27]

Bearing this in mind, it is useful to compare columns 1 and 3, and columns 2 and 4 in Table 1. To begin, exports are determined solely by exogenous external demand and relative prices so that the proportionate changes reported in columns 1 and 2 are the same as those in columns 3 and 4. The source of the difference generated by the balanced budget is identified in the final row of columns

3 and 4. These are the reductions in real regional government consumption – in our case the Scottish government – required to balance the budget. The cut is slightly greater for the national insurance simulation.. The impact of the lower public expenditure is to reduce the expansion in regional GVA in both cases by 0.20 percentage points. Because of the sectoral composition of public expenditure, with a relative concentration on labour intensive services, the increase is lower by 0.23–0.25 percentage points for employment and 0.15–0.16 percentage points for investment.

The overall impact of implementing the balanced-budget tax cuts in Levelling Up 2 is therefore the net effect of two partially offsetting stimuli; the expansion in exports generated by increased competitiveness and the reduction in government expenditure required by the public finances. For both tax cuts the net effect on regional economic activity is positive. GVA, employment, investment and household consumption all rise but by less under Levelling Up 2. The downward adjustment in public spending reduces the expansionary effect by around a third but the impact on economic activity is still strongly positive.

5.2. Fixed labour force

Where the labour force remains constant, the expansionary impacts reduce the unemployment rate below its initial level of 6% and increase the real wage through the operation of the wage curve. This curbs the improvement in competitiveness which limits the rise in economic activity and increases the cost of labour to firms relative to the cost of capital, producing further substitution effects. The results for Levelling Up 1 and 2 are shown in columns 1–4 of Table 2; the results for Levelling Up 3 are presented in columns 5 and 6.

Begin by considering the impact of the corporation tax cut under Levelling Up 1, which is reported in the first column in Table 2. Note first that the changes in regional economic activity are strongly affected by the absence of migration; the 0.38%, 0.28% and 0.20% increases in GVA, household consumption and employment are around one-half, four-fifths and one-third, respectively, of the corresponding figures reported in Table 1. With no migration, real and nominal wages increase by 0.36% and 0.24% but the fall in the user cost of capital is still substantial, at 0.82%, so that there remains a 0.12% reduction in the cpi and a 0.17% fall in the export price index. The improvement in price competitiveness delivered by the fall in corporation tax is therefore considerably reduced.[28] The economy also becomes even more capital intensive with the 0.62% increase in investment now three times the proportionate increase in employment.

The effect of the reduction in the national insurance contributions under Levelling Up 1 where the labour force is constant (and public expenditure is fixed) is shown in the second column in Table 2. The limiting effect of the real wage adjustment is even greater in this case. This is not surprising. Recall that in the fixed real wage simulations, reported in Table 1, the employment increase is much greater for the reduction in national insurance, as against corporation tax. Where the wage curve operates but inter-regional migration is precluded, the increases in real and nominal wages are 0.43% and 0.38%, respectively. When the tax cut is also factored in, the fall in the nominal price of labour to the firm is now 0.17% (as against 0.80%) and the reduction in the export price index is only 0.07%. In this case GVA and employment both rise by 0.24%, whilst household consumption and the real wage increase by 0.35% and 0.43%, respectively.

Where we impose the balanced budget, under Levelling Up 2, the results are shown in the third and fourth columns in Table 2. The introduction of this government budget constraint has an impact similar to that experienced with the fixed real wage simulations reported in Table 1. However, with a flexible real wage the additional negative impact is much less pronounced because the reduction in public sector consumption simultaneously improves competitiveness. Some of the negative effects of the approximately 1% reduction in local public expenditure are offset by an increase in exports which now rise by 0.59% and 0.39%, respectively, in the corporation tax and

national insurance simulations. However, this having been said, for both tax reductions the increases in GVA, household consumption, investment, and employment are all lower once a balanced budget is imposed.

The effects of Levelling Up 3, where all regions pursue an expansionary fiscal policy by reducing taxation, are reported in the fifth and sixth columns of Table 2. The main differences from the Levelling Up 2 results given in the third and fourth columns is that impacts of both the corporation tax and national insurance reductions are significantly lower, though they remain positive; the value added stimulus generated by the corporation tax and national insurance reductions fall by nearly one-fifth and over one-third, respectively. When all regions adopt the same policies, this puts downward pressure on RUK prices, which ultimately fall by 0.38% and 0.24%, eliminating the competitiveness gain of the individual region vis a vis RUK, resulting in no change in RUK exports. This limits the stimulus to demand and moderates upward pressure on employment and the real wage. While the wage change and the reduction in import prices mitigates the net impact of the fall in demand – in part through a stimulus to ROW exports – the increases in consumption, investment and value added are all still lower than is the case for Levelling Up 1 and 2.[29]

Levelling Up 3 significantly reduces the efficacy of the use of devolved fiscal powers, but importantly does not eliminate it. Note that this is a rather extreme case. Intermediate positions, where some regions are given devolved powers (e.g., only the 'left behind') but others are not would generate results for the favoured regions somewhere between Levelling Up 2 and 3.

5.3. The importance of openness and extension to other regions

Our model accommodates the heterogeneity across regions by allowing capturing variation in key regional characteristics that are likely to influence the impact of regional fiscal policies. Here we explore two important features in this context, namely the degree of openness of the labour and goods markets.

Table 3 shows the effect on employment of a 0.51% Levelling Up 2 reduction in national insurance when we vary the openness of goods markets, reflected in the Armington elasticity, and of labour markets, embodied in the migration response. The rows correspond to the Armington values, which range from 1 to 5, where 2 is the default level. The columns identify the degree of openness of the labour market represented by the long-run labour force adjustment with values between 0% and 100% of the long-run flow-migration equilibrium value. The employment changes using the default Scottish parameter values, reported in Tables 1 and 2, are 0.14% with zero labour mobility and 0.47% for the 100%, long-run flow-migration outcome. These are the left- and right-hand-side figures in the second row of Table 3. Increased trade price elasticities augment the demand stimulus from an improvement in competitiveness and

Table 3. The employment impacts of a 0.51% balanced budget reduction in national insurance for alternative degrees of labour and goods market openness.

Armington elasticity	0%	20%	40%	60%	80%	100%
1	0.12%	0.17%	0.21%	0.26%	0.30%	0.35%
2	0.14%	0.20%	0.27%	0.34%	0.40%	0.47%
3	0.16%	0.24%	0.33%	0.41%	0.49%	0.58%
4	0.17%	0.27%	0.38%	0.48%	0.59%	0.69%
5	0.18%	0.31%	0.43%	0.56%	0.68%	0.81%

greater migration responses put further downward pressure on real wages which adds to the boost to competitiveness from the tax cut.[30]

Goods and labour market characteristics vary across regions, which in turn affect the impact of local fiscal interventions. For example, designated free ports typically cover a relatively small area and are geographically well connected to other regions. We would therefore expect high values for both product and labour market openness with an accompanying substantial expansion in local economic activity for reductions in NI contributions or corporation tax. On the other hand, a large NUTS-2 peripheral region, such as the Scottish Highlands and Islands, is likely to have low levels of openness limiting policy effectiveness. Regions might also exhibit asymmetric degrees of openness; a remote resource intensive region will be export intensive with high goods, but low labour, market openness.

6. DYNAMICS

The long-run results reported in Section 5 are achieved through the updating of the capital stock and, where appropriate, the labour force. These adjustments occur between periods through net investment and inter-regional migration. The long-run perspective seems appropriate for policies whose aim is to stimulate economic development. However, when operated in period-by-period mode, the model indicates that the long-run outcome can take up to 40 periods to be attained. Therefore, the speed of adjustment and the precise time path taken to long-run equilibrium have direct policy relevance.[31]

6.1. Regional GVA
Figure 1 gives the regional GVA figures for the Levelling Up 1 and 2 simulations shown in Tables 1 and 2. Most of these time paths have a similar form: the GVA increases at a diminishing rate to asymptotically approach the long-run values. However, some additional points are worth noting.

Begin by focusing on the simulations with migration which are represented in Figure 1 by the solid lines. At least four characteristics are of interest. The first is the length of time that it takes for these adjustments to occur. For the national insurance simulations, the increase in GVA reaches half its long-run value between periods 5 and 7, and for the corporation tax between periods 7 and 9. Recalling that each period is a year, this means that

the bulk of the benefit of such tax reductions will typically be felt outwith the time span of any government's current term of office.

The second observation is that the national insurance adjustment path is more rapid than that for the corporation tax, where GVA initially falls if the balanced budget is imposed. In the first period, one of the effects of the cut in corporation tax is that it operates as a windfall gain to the owners of capital. Where the public sector is operating with a balanced budget, essentially income is transferred from the public sector account to capital owners. Therefore, part of the initial impact is simply a transfer of consumption demand from the public to the household sectors.

All income in the public account is consumed on domestic goods and services, whereas some of the income to capital will go immediately to owners domiciled outwith the region. Of the income that remains, some will be saved and of the subsequent change in household consumption, some will go on imports. Finally, the public sector demand is typically on more labour-intensive activities than is household demand. The impact of the initial shift in income therefore has a negative impact on expenditure, with corresponding downward multiplier effects.[32]

The reduction in the cost of capital implied by the cut in corporation tax also stimulates investment and in the initial period this is experienced simply as a demand shock. However, the impact is less than the decline in consumption, so that GVA and employment fall. Over time, the effect of the increase in capital stock generated by the additional investment brings about a fall in the capital rental rate which reduces the price of the output of domestic sectors, stimulating exports and, where applicable, increased real wages.

The third issue is that because regional economic activity initially adjusts more rapidly in the national insurance simulations, in the earlier periods the associated GVA increases are greater than those for the cut in corporation tax. Where migration is present, it is not until period 10 with the fixed government budget and period 13 with the balanced budget that the GVA growth with the corporation tax adjustment dominates that generated by the reduction in the national insurance contributions.

A fourth point is that the adjustment with the balanced budget is slower than with the fixed budget.

Where the labour force is held constant, the dynamics are similar, but the adjustment is faster; the absolute size of the long-run GVA increases are now lower and the
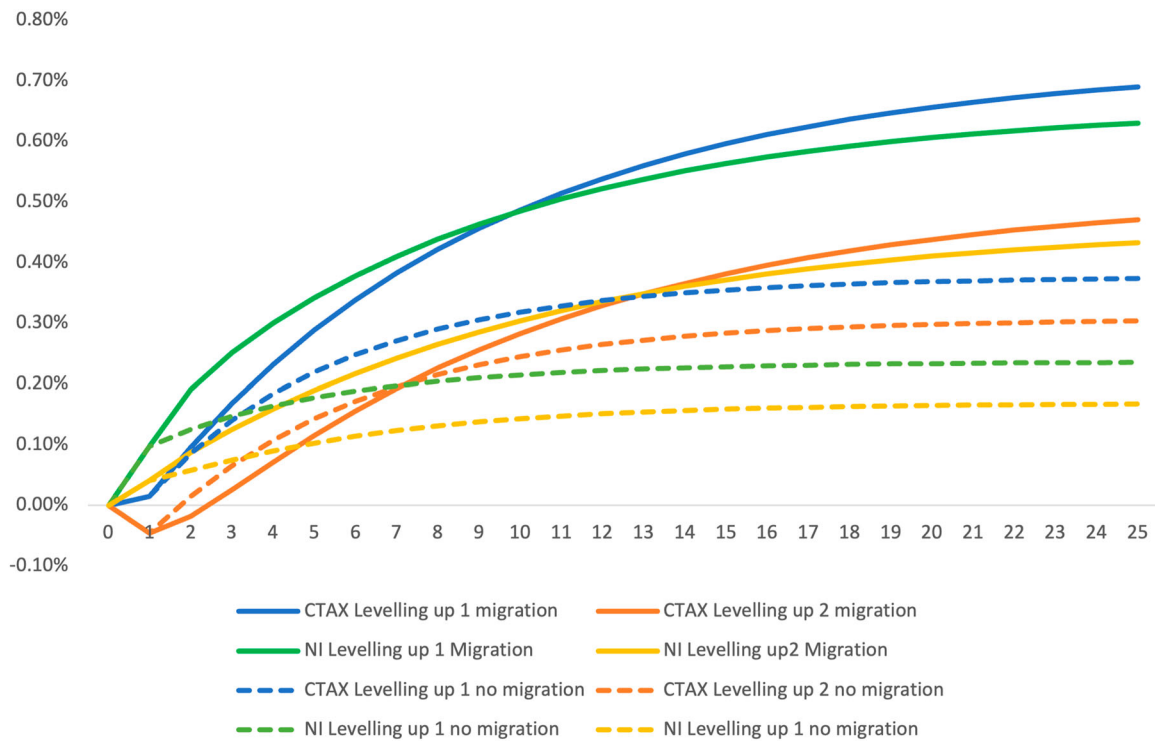
Figure 1. The time paths of regional gross value added (GVA) responses to reductions in corporation tax and national insurance.

economy no longer has to adapt to changes in the labour force. In all cases the impact on regional GVA reaches half its long-run value within five years, sometimes much sooner. We again get changes in the ordering of the national insurance and corporation tax cut GVA effects in initial periods, but this is reversed by period 3.

The capital stock adjustment process that we adopt here is not forward looking; firms attempt optimally to adjust capacity to existing, rather than projected future, output. Similarly, households are assumed to be myopic with consumption linked to current income. We have run test simulations with alternative formulations of the
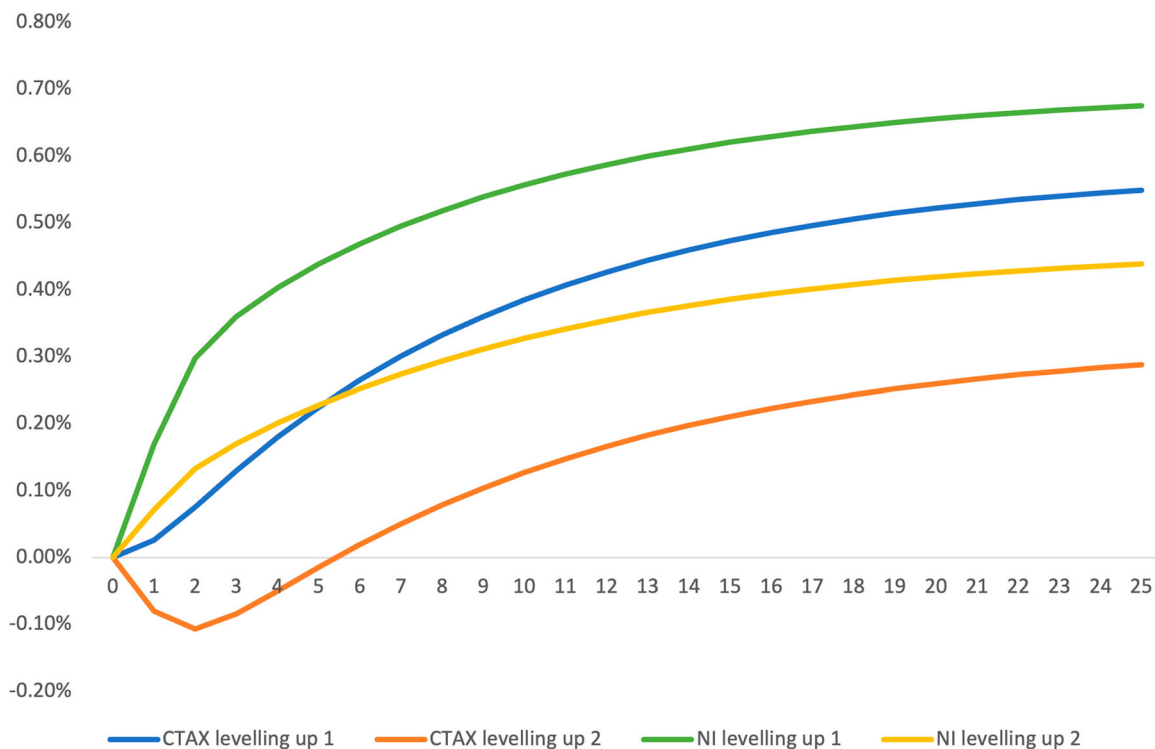

Figure 2. The time paths of regional employment responses to reductions in corporation tax and national insurance with migration.

investment and consumption functions which are fully forward looking. This does not change the long-run equilibrium values, nor the distinctive qualitative characteristics of the adjustment process. However, the speed of adjustment is increased. As examples, with the forward-looking investment and consumption functions, the GVA figures with migration and the balanced budget now reach half their long-run values in the corporation tax and national insurance simulations in periods 4 and 6, respectively. This is against periods 7 and 9 in the corresponding simulations reported in Figure 1. Again, with the change in corporation tax, flow equilibrium migration and a balanced budget, employment change is negative for the first 2 and 3, as against 3 and 5, periods.

6.2. Regional employment and real wages
Figures 2 and 3 give the time paths for the employment and real wage outcomes for the simulations with interregional migration. Figure 4 reports the employment values where the labour force is fixed.

With migration, the expansion in employment broadly mirrors that in GVA. However, there are two important points of difference. The first is that because the long-run employment impacts are greater for the national insurance reduction, the ordering of the employment impacts between the national insurance and corporation tax adjustments are always the same; for a given fiscal framework and time period, the national insurance employment figure is always greater than the corporation tax one. The second is that for the corporation tax reduction, with a balanced budget, the initial period of reduced activity is more extended for employment which is below the base period level for the first five periods.

The changes in the real wage for the simulations with migration are shown in Figure 3. We know that in this case there is no change in the long-run real wage.[33] If a key aim of the government is to increase average household income in aided regions, then in this case the policy has limited effectiveness. There are short-run real wage increases in all cases after period 2 which incentivise regional in-migration, but these are relatively small. However, if an additional aspect of the policy is to stem outmigration then in this instance it clearly is effective.

Figure 4 shows that where the national insurance reductions occur with a fixed labour force the employment impacts are much lower but occur very rapidly. With the fixed and balanced budgets (Levelling Up 1 and 2) over two-thirds and one-half, respectively, of the long run adjustment occurs in period one. For the corporation tax reduction, again we get a lengthy period where employment is below its initial value under Levelling Up 2 and this must be a concern with this policy. With the labour force fixed there is an inverse link between variation in employment and variation in the unemployment rate. Changes in the real wage, driven by the wage curve therefore directly mirror changes in employment, so these real wage changes are not shown here. However, recall that the long-run Levelling Up 1 and 2 increases in the real wage are 0.43% and 0.28% with the reduction in national

insurance. The wage increases with the cuts in corporation tax are lower, particularly where the balanced budget constraint is imposed.

6.3. The importance of adjustment speeds and extension to other regions
Regions are likely to differ in terms of their speed of adjustment to fiscal stimuli as well as in their long-run equilibria. This is important because policymakers are likely to be most concerned about impacts over the expected duration of their administration. Variation in the speed of adjustment is generated through parameter changes in the investment and migration functions, equations (1) and (3). The full analysis of the consequences of varying adjustment speeds on the impact of Levelling Up 2 reductions in national insurance contributions and corporation tax on employment and GVA is provided in Appendix D in the supplemental data online.

As we would expect, the speed of adjustment of employment to its long-run equilibrium level proves to be positively related to both the migration and the capital adjustment parameters. So, in addition to the choice among Levelling Up options, the government could also adopt policies to secure faster results. For example, tax breaks linked to investment expenditure (rather than corporation tax) and schemes aimed at assisting the mobility of key workers would be expected to improve the adjustment speeds of capital and labour, respectively.

7. DISCUSSION

The Levelling Up White Paper identifies 12 missions (HM Government, 2022b). One of the two outcomes-based missions is, by 2030, to improve living standards and reduce the existing regional disparity. The metrics for this mission are GVA per hour worked, gross median weekly pay and 16–64-years-old employment rates.[34]

We compare both the corporation tax and national insurance reductions under three possible levelling up policies, which differ in terms of financing and the number of regions with devolved tax powers, under two labour market closures. We also investigate how characteristics of regions impact the efficacy of devolved fiscal policies in both the short and long runs. Although the impacts differ quantitatively, the qualitative results show a degree of consistency.

In every case where there is less than perfect inter-regional labour mobility, the tax reduction eventually stimulates all the aggregate variables taken to increase living standards in the White Paper, with the scale of the response reflecting the chosen Levelling Up policy. Where flow-equilibrium migration occurs, the real wage and employment rates are restored to their initial levels, and with the national insurance simulation, GVA per employee is unchanged or falls slightly; so, strictly, the only headline metric that moves as intended is productivity – in response to the reduction in corporation tax. However, positive impacts on other variables that are likely to feature in measures of well-being, and have featured as past objectives of regional policy, including
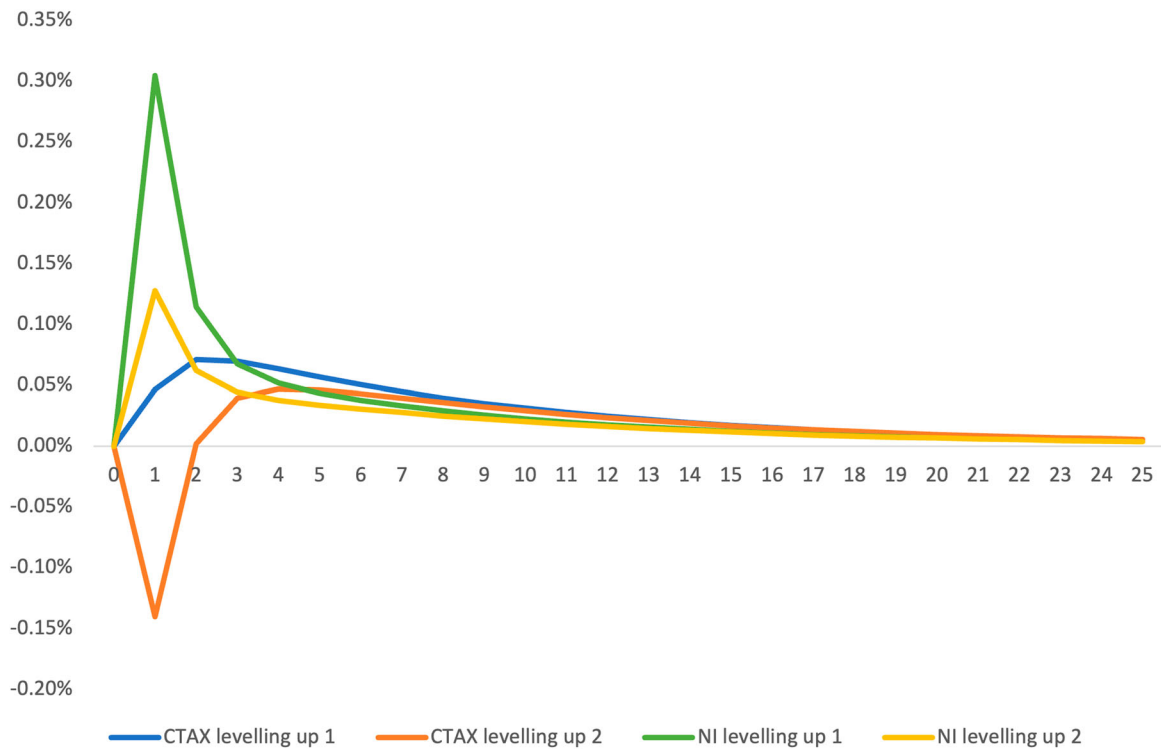
Figure 3. The time paths of the regional real wage responses to reductions in corporation tax and national insurance with migration.

the levels of GVA, employment and household consumption, are typically enhanced by greater labour mobility. Furthermore, during the extended adjustment period, real wages and the employment rate increase for both taxes under Levelling Up 1 policies and for national insurance under Levelling Up 2. In contrast, balanced budget corporation tax reductions often adversely impact real wages and employment rates in the short run.
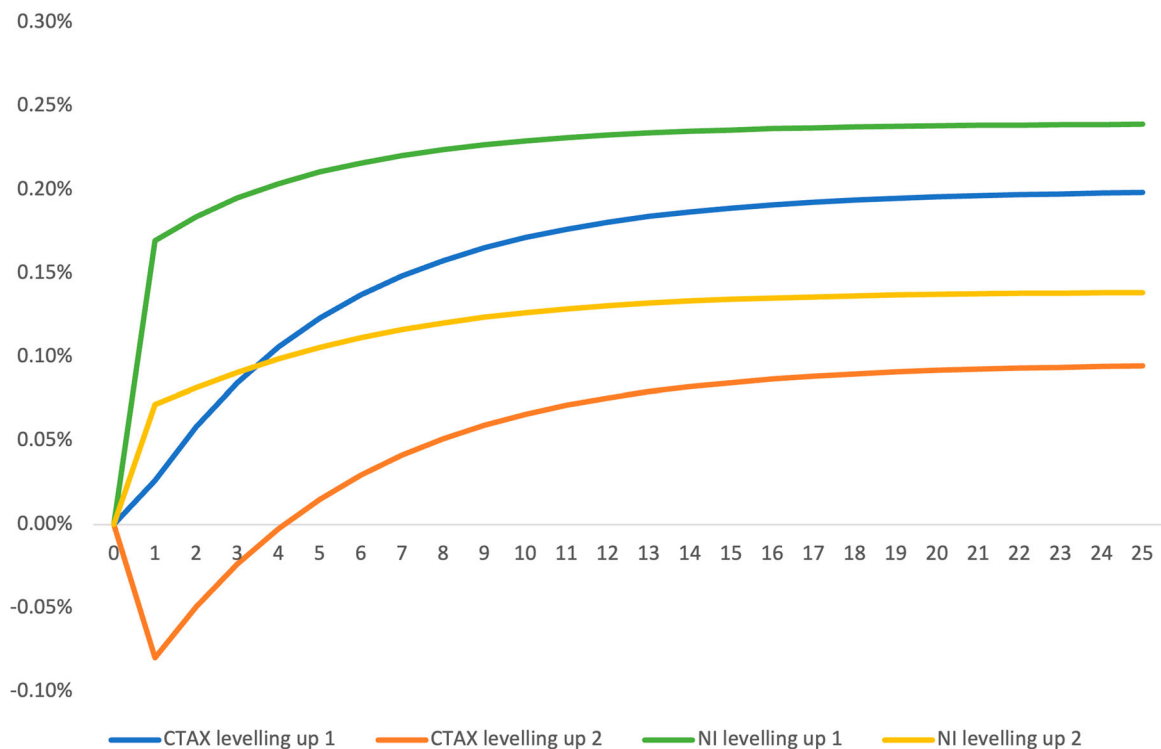

Figure 4. The time paths of employment responses to reductions in corporation tax and national insurance with fixed labour force.

The stimulus of reduced taxes comes primarily through an expansion in exports and investment. Sectors of the economy that focus on these markets especially benefit. It is important to stress that although economic activity increases, where balanced budget constraints are imposed, the public sector provision of services falls. Where the welfare or well-being of residents – the other outcome-oriented mission identified in the Levelling Up White Paper – is considered, any increase in household private consumption must be set against this reduction in public consumption.[35] This accompanied by significant falls in employment in the public sector.

Whilst there are many similarities, there are also systematic differences in the impact of the corporation tax and national insurance reductions. Such differences in outcome seem to be conflated or simply not acknowledged in the White Paper. Whilst in our simulations both tax rates are calibrated to deliver the same cost cut in the absence of any subsequent endogenous adjustments, the positive effect on GDP, exports and investment is ultimately greater for the corporation tax, whilst the positive impact on employment and household consumption is more pronounced with the fall in national insurance payments. The Levelling Up White Paper does not indicate the weight placed on the different policy metrics, nor is it likely that the intention is to attach zero weight to key past objectives of regional policy (including employment), which are not included. Our results point to trade-offs among stated headline metrics and between those and the wider set of potential regional policy goals. Our simulations imply that the appropriate policy mix should be determined by well-defined policy objectives.[36]

A second issue concerns the clear conflict revealed in these results between accountability and effectiveness. Those UK areas that are identified as being 'left behind' often claim to have received inadequate funding from central government. This would suggest that additional regional industrial aid should be financed centrally with the beneficial effects identified here under Levelling Up 1. However, an important strand in the discussion about levelling up and devolution, argues for greater local autonomy and financial accountability. Such accountability reduces the local demand stimulus provided by tax reduction under Levelling Up 2 and 3, but importantly does not eliminate it,[37] and would also leave the local population with lower levels of public services. But lower provision of public goods is frequently cited as a characteristic of 'left behind' regions. A wider range of issues are involved in the choice among different Levelling Up policies. Moreover, the options need not be either/or. The Scottish and Welsh governments, which both have industrial development remits, receive direct funding from both the UK government and local taxes. The relative merits of these approaches for tackling regional inequality are not sufficiently discussed.

A third important topic involves the nature of, and variation in, the time paths of the impacts of these policy interventions. The simulation results presented here suggest that it can take up to 40 years for long-run equilibrium to be reinstated. Those policies that have the best outcomes in the long run can perform less well, and even negatively, over shorter time periods. A classic example is the comparison of the regional GVA impacts of the two tax cuts under Levelling Up 2. Whilst the corporation tax cut performs the best over the long run, it underperforms the reduction in national insurance payments for the first 15 years. Perhaps of greater concern to policymakers is the impact of the corporation tax reduction on local employment again under Levelling Up 2. Independently of the nature of the labour market closure used here, employment is lower than the base year value for four to five years after the introduction of the tax cut. Whilst more forward-looking investment and consumption functions increase the speed of adjustment, the qualitative comparative nature of the adjustment process remains. Additional policies may be required if the benefits of tax cuts are to be felt within the duration of the current administration.

Fourthly, the nature of inter-regional migration has important implications for the interpretation of the regional problem and the effectiveness of policy interventions. If the aim of regional policy is to increase regional economic activity, then high levels of inter-regional migration are beneficial. On the other hand, if the objective is to increase local wage rates and average household incomes, then greater labour mobility is unhelpful.[38]

Finally, the degree of openness of goods markets as well as labour markets and the adjustment speeds of capital stocks and migration all prove potentially important for policy.

8. CONCLUSIONS

The main function of these simulations is to stimulate discussion around crucial regional policy issues and the interaction of regional policy and devolved decision-making. These are central to the levelling up debate. It is a very opportune time to consider the additional powers to be devolved particularly to the English regions and the spatial policies pursued from the centre.

Using spatially targeted capital and labour taxes can make a significant contribution to tackling regional inequalities. However, they have differential impacts on the levels, composition and evolution of the changes in economic activity. Further, whilst the devolution of such taxes can enhance economic activity in targeted regions, the simulations reveal a clear conflict between accountability and effectiveness; while central funding may limit accountability, it also enhances effectiveness.

It is important to stress that these simulations only tell part of the story. They do not address, for example, supply-side and welfare/well-being issues associated with reductions in public expenditure and increased migration. Further they are silent on the dynamic issue of technical change, its link to investment and selective migration, issues around skill disaggregation and the wider dimensions of well-being.

Finally, our analysis deals with policy interdependence only in the limiting case where all regions pursue identical

regional fiscal policies. Our study shows that this restricts, but does not eliminate, the efficacy of devolved policy, and the results allow us to infer the likely impact of less extreme cases. More general issues of interaction between devolved regions are, however, missing from the simulations reported here, as indeed they are from the UK government's levelling up agenda.

Whilst there is strong current UK rhetorical support for a revitalised spatial policy with recent description and analysis of the nature of UK's spatial problems and possible policy solutions (Martin et al., 2021; HM Government, 2022a), many issues require further research. The issues highlighted in this paper include the nature of local fiscal regimes and their distribution across connected regions, the importance and role of migration, the characteristics of financial aid and the time scale over which policy acts.

NOTES

1. This has led to some highly publicised transfers of central civil service positions to locations distant from London, such as the new HM Treasury campus in Darlington.
2. This is the proposed 12th and final 'mission' outlined in the document.
3. Corporation tax is a tax on profits. Other, more minor, taxes have also been devolved. For a concise summary, see Institute for Government (2021). For the present position in Northern Ireland, see NI Fiscal Commission (2021).
4. This idea has the support of Jake Berry, chairman of the Northern Research Group of Conservative MPs representing seats in the North of England (Berry, 2021).
5. This position is also supported by the main opposition Labour Party; https://labour.org.uk/keir-starmer-union-speech/
6. In fact, in February 2022, the UK and Scottish governments agreed to establish two new green freeports in Scotland.
7. Employers' national insurance is a tax paid by employers at a fixed percentage of their employees' earnings above a threshold. Other tax reliefs include business rates, stamp duty land tax (SDLT), enhanced structures and building allowance and enhanced capital allowances.
8. Although we model the employers' national insurance contribution as a proportion of the wage, its actual operation is slightly more complex.
9. However, there might be differences in the short-run dynamics, particularly if capital support takes the form of investment subsidies.
10. Devolved decision-making was also the basis for the post-1997 Labour government's regional policy which introduced the devolved administrations in Scotland and Wales and set up regional development agencies and government offices in all the other NUTS-1 English regions, governed by a policy of 'Constrained Discretion' (HM Treasury/DTI/ODPM, 2003; McGregor & Swales, 2005).

11. Where a policy change occurs solely in one small open region, a single-region approach is appropriate as, for example, in the analysis of Scottish income tax changes in Lecca et al. (2014). Where a policy initiative necessarily impacts all regions simultaneously, as in the case of leaving the EU, a multiregional approach is essential even if the primary focus is a single small region (Figus et al., 2018).
12. Previous examples of region-wide capital or labour subsidies only occurred in the mid-1960s and early 1970s.
13. Appendix A in the supplemental data online provides a brief overview of the rather complex structure of spatial governance in the UK.
14. For statistical purposes, since 2021 the ONS uses ILT, rather than NUTS, to reference spatial subdivisions of the UK.
15. AMOS = A Macro–micro model Of Scotland.
16. ROW prices are held constant at their base-period level across all simulations reported here. RUK prices are unchanged for Levelling Up 1 and 2, but under Levelling Up 3 adjusted off-model to equal the change in regional prices.
17. The model also has a forward-looking investment option, which imposes perfect foresight and adjustment costs. Adopting this option would not change the long-run equilibrium but would in this case have the adjustment process occurring slightly faster. This is discussed in more detail in Section 6.
18. Sections 5.3 and 6.3 further extend this analysis.
19. There is assumed no natural change in population.
20. The consequences of adopting a forward-looking model variant are briefly discussed in Section 6.1.
21. Of course, as will become clear, the indirect and induced effects of the two fiscal changes can differ.
22. The reduction in corporation tax is a policy that has previously been advocated by the SNP.
23. At the time this was also required by EU regulations.
24. Ignoring these potential supply-side impacts is non-trivial. The Levelling Up White Paper stresses that unequal or inappropriate access to key public goods, such as healthcare and education, causes regional productivity differences.
25. This is a likely outcome of the 'race to the bottom' case.
26. The lower increase in household consumption partly reflects the fact that in these simulations government transfers are held constant in real terms.
27. The absolute size of the reduction is discussed in more detail in Section 5.3.
28. Recall that with flow equilibrium migration the fall in the export price index is 0.41%.
29. We also explored the income distributional impacts. As expected the national insurance cut operates in a very similar way to a cut in income tax, with gains typically favouring higher income households. The corporation tax cuts have a less clear pattern across income groups. In both cases, of course, the scale of the effects diminishes as we move through Levelling Up 1–3.
30. Appendix D in the supplemental data online provides a fuller discussion of the impact of openness on long-run equilibria.

31. Adjustment paths for the Levelling Up 3 case of all regions pursuing expansionary fiscal policy would require a full interregional model.

32. In the analysis of investment grants, rather than the corporation tax reduction, this initial large transfer would not occur. This would significantly affect the adjustment path.

33. The interpretation of base-year variation in the real wage across regions is that this reflects differences in amenities, commuting time, etc.

34. The second outcome-based mission is well-being, quantified by a small rage of self-reported measures at local authority level. There is no mention of formal measures of welfare as used by economists.

35. Our modelling only captures the elements of well-being linked directly to economic activity. As HM Government (2022) acknowledges, the assessment of policy impacts on well-being as a whole presents major measurement challenges.

36. In the past, employment has often explicitly been taken as the main target variable. The cost per job estimates reported in Tables 1 and 2 are the lost revenues from the tax whose rate has been cut divided by the net increase in employment. These vary significantly across fiscal arrangements – being considerably smaller for fixed public expenditure cases and for national insurance rather than corporation tax changes.

37. The regional distribution of devolved tax powers also matters; devolved tax policies are rather less effective when they are pursued by all regions simultaneously as under Levelling Up 3.

38. But recall we assume migration simply leads to adjustments in the labour force. We assume migrants are identical to the existing workforce.

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